



FINAL

**SEATTLE SHORELINE PARK INVENTORY
AND HABITAT ASSESSMENT**

Prepared for

Seattle Parks and Recreation

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Table of Contents

1	EXECUTIVE SUMMARY	ES-1
1.1	Salmonid Occurrence and Use of Project Area	ES-1
1.2	Approach and Methods.....	ES-2
1.3	Prioritization Results.....	ES-2
1.4	Conclusions	ES-3
2	INTRODUCTION.....	1
3	LITERATURE REVIEW AND BACKGROUND INFORMATION	2
3.1	Definition and Importance of Littoral and Nearshore Environments	2
3.2	Salmonid Occurrence at Seattle City Parks.....	2
3.2.1	Chinook Salmon	2
3.2.1.1	Freshwater	2
3.2.1.2	Estuarine and Nearshore.....	3
3.2.1.3	Chinook Occurrence at Specific City Parks and Lake Areas.....	3
3.2.2	Coho Salmon.....	4
3.2.3	Chum Salmon	5
3.2.4	Pink Salmon	5
3.2.5	Sockeye Salmon	5
3.2.6	Steelhead Trout.....	6
3.2.7	Coastal Cutthroat Trout	6
3.2.8	Bull Trout.....	6
3.3	Ecological Functions Provided by High-Quality Salmonid Habitat	7
3.3.1	Prey Availability.....	8
3.3.1.1	Freshwater	8
3.3.1.2	Saltwater	8
3.3.2	Refuge	9
3.3.2.1	Freshwater	9
3.3.2.2	Saltwater	10
3.3.3	Migratory Corridors.....	11
3.3.3.1	Freshwater	11
3.3.3.2	Saltwater	11
3.4	Summary of High Quality Habitat Characteristics.....	11
4	APPROACH AND PRIORITIZATION METHODS.....	13
4.1	Project Objective and Approach.....	13
4.2	Methods	15
4.2.1	Literature Review	15
4.2.2	Field Data Collection	15
4.2.3	Restoration Prioritization and Identification of Conservation Reaches	17
5	RESULTS.....	21
5.1	Restoration Sites.....	21

Table of Contents

5.1.1	Rainier Beach Lake Park.....	24
5.1.1.1	Current Reach Conditions.....	24
5.1.1.2	Reach Restoration Priorities and Restoration Prescription.....	24
5.1.1.3	Restoration of Ecological Functions for Juvenile Salmonid Habitat	25
5.1.2	Beer Sheva Park	25
5.1.2.1	Current Reach Conditions.....	25
5.1.2.2	Reach Restoration Priorities and Restoration Prescription.....	29
5.1.2.3	Restoration of Ecological Functions for Juvenile Salmonid Habitat	29
5.1.3	Martha Washington Park	31
5.1.3.1	Current Reach Conditions.....	31
5.1.3.2	Reach Restoration Priorities and Restoration Prescription.....	31
5.1.3.3	Restoration of Ecological Functions for Salmonid Habitat.....	33
5.1.4	Pritchard Island Beach.....	34
5.1.4.1	Current Reach Conditions.....	34
5.1.4.2	Reach Restoration Priorities and Restoration Prescription.....	36
5.1.4.3	Restoration of Ecological Functions for Juvenile Salmonid Habitat	36
5.1.5	Seward Park	38
5.1.5.1	Current Reach Conditions.....	38
5.1.5.2	Reach Restoration Priorities and Restoration Prescription.....	40
5.1.5.3	Restoration of Ecological Functions for Juvenile Salmonid Habitat	40
5.2	Conservation Sites	42
5.2.1	Highest Conservation Priority.....	42
5.2.2	High Conservation Priority	44
5.2.3	Other Conservation Areas.....	44
6	CONCLUSIONS	46
7	REFERENCES	47



List of Tables

Table 1. Essential Habitat Functions and Habitat Parameters Collected at Seattle City Shoreline Parks

Table 2. Reach Restoration Priorities Identified for Seattle City Shoreline Parks

List of Figures

Figure 1. Seattle Shoreline Parks Inventoried for Restoration Prioritization

Figure 2. Restoration Prioritization Scoring System

Figure 3. Highest Priority Restoration and Conservation Sites

Figure 4. Rainier Beach Lake Park Priority Restoration Site Reach Rankings

Figure 5. Rainier Beach Lake Park Restoration Opportunities

Figure 6. Beer Sheva Park Priority Restoration Site Reach Rankings

Figure 7. Beer Sheva Park Restoration Opportunities

Figure 8. Martha Washington Priority Restoration Site Reach Rankings

Figure 9. Martha Washington Park Restoration Opportunities

Figure 10. Pritchard Island Beach Priority Restoration Site Reach Rankings

Figure 11. Pritchard Island Beach Restoration Opportunities

Figure 12. Seward Park Priority Restoration Site Reach Rankings

Figure 13. Seward Park Restoration Opportunities

Figure 14. Sites with High or Very High Conservation Priority

List of Appendices

Appendix A. Freshwater and Marine Data Dictionaries

Appendix B. Decision Rules for Habitat Parameters

Appendix C. Decision Rules for Restoration and Conservation Priorities

Appendix D. Table of Restoration and Conservation Priorities

Appendix E. Prioritization Maps for Seattle Shoreline Parks

Appendix F. Design Recommendations

Appendix G. Field Data Log

1 EXECUTIVE SUMMARY

This overall goal of this project was to inventory Seattle Parks and Recreation's (Parks) shoreline properties and identify opportunities for salmonid habitat restoration and conservation. The assessment approach led to a ranking of restoration opportunities that explicitly considered current park uses. The parks included in the study were those on Lake Washington, the Lake Union/Ship Canal to the Locks, and on Puget Sound/Elliott Bay. In this report, we summarize scientific knowledge of the project area, the approach and methods of the prioritization process, and the results and conclusions in light of restoration and conservation opportunities. The City of Seattle and King County have completed several studies documenting salmonid use of Seattle's urbanized shorelines. Ongoing fish studies of juvenile salmonid use of Lake Washington by Roger Tabor (U.S. Fish and Wildlife Service) and others continue to provide more specific scientific findings. Rather than duplicate these efforts, this study applies them to Parks' extensive shoreline properties.

1.1 Salmonid Occurrence and Use of Project Area

Salmonids utilizing shoreline parks include chinook, coho, chum, pink, and sockeye salmon, and steelhead, coastal cutthroat, and bull trout migrating from the Cedar River, the Duwamish and Green Rivers, the Sammamish Slough, and various smaller streams. Salmonid ecology literature describes five primary ecological functions that nearshore habitats provide for juvenile salmonids:

- Prey Availability
- Predator Refuge
- Migration Corridors
- Physiological Refuge
- High Energy Refuge

Site-specific habitat requirements for juvenile salmonids in Lake Washington, Lake Union, and the Ship Canal include small substrates, shallow gradients, overhead cover, unarmored banks, and limited or no barriers to migration; Puget Sound juvenile salmonids also require eelgrass beds, marine riparian vegetation, and diverse substrate types. From a landscape perspective, all juvenile salmonids require the spatial distribution of refuge, cover, and food, as well as connectivity within and between habitats.

1.2 Approach and Methods

Our approach was based upon the links between habitat features and the ecological functions the features provide. We divided each park into a series of reaches, conducted fieldwork to characterize reach-specific features, and developed a scoring system for prioritizing habitat restoration based on the ecological function. In the scoring system, this habitat information was considered with a landscape perspective (park locations relative to high-quality habitat) and current recreational park uses (pedestrian trails, boat ramps, visual shoreline access, and swimming beaches) to evaluate potential restoration opportunities (see Figure 2). We assigned a Reach Restoration Priority for each reach, using a set of decision rules for each factor. Restoration opportunities were evaluated relative to the feasibility of implementing restoration projects at these parks, based on the opportunities and constraints posed by park uses.

1.3 Prioritization Results

From the list of all parks considered, five parks were identified as candidates for restoration based on high potential to provide the most benefit from restoration and the most workable combinations in terms of park habitat condition, position in the landscape, and park use. Three were chosen because they contained reaches with *very high priority* rankings based on a high potential for restoration, a position near the mouth of the Cedar River, and complete feasibility for restoration based on park uses. These parks include the following:

- Rainier Beach Lake Park
- Beer Sheva Park
- Martha Washington Park.

Two more parks, Seward Park and Pritchard Island Beach, were chosen based on a combination of two factors; 1) they contained reaches with a *high priority* ranking and 2) they have substantial potential to contribute to juvenile salmonid habitat based on known fish use areas relative to the Cedar River.

Restoration prescriptions for these parks include a suite of changes, including the removal of shoreline modifications that interfere with salmonid habitat quality, adding habitat features, and maintaining current park uses where necessary. Applying the identified

restoration prescriptions to these parks would address each of the ecological functions described above as necessary for juvenile salmonid survival in nearshore and littoral areas.

Four parks contained reaches identified as having very high conservation value:

- Colman Park
- East Montlake Park
- Matthews Beach
- Discovery Park

These reaches were characterized as unarmored, gently sloping shorelines, with small or detritus-rich small substrates, large woody debris, and abundant cover provided by native vegetation. Within their respective parks, these reaches should be conserved to maintain their habitat value.

Five more parks contained reaches identified as having high conservation value:

- Rainier Beach Lake Park
- Atlantic City Boat Ramp/Beer Sheva Park
- Martha Washington Park
- Golden Gardens Park
- Lincoln Park

Additional areas to be conserved include forage fish areas, areas with eelgrass patches, and swim beaches.

1.4 Conclusions

This project combined a biology-based salmon habitat suitability evaluation with a park/recreation-based feasibility to prioritize shoreline parks for restoration and conservation potential. The intent was to match the sites with the potential benefit to salmon with those that have the least recreational use conflicts. There is a strong correlation between these two components in south Lake Washington (see Figure 3).

This project provides two important tools for implementing habitat restoration projects at Seattle shoreline parks. First, the information gained from using park reaches to describe

habitat features provides essential site-specific information useful for planning workable, detailed restoration prescriptions for particular shoreline areas. Second, these results provide a way to organize restoration opportunities across diverse shoreline parks while balancing recreational uses with juvenile salmonid needs and requirements. The next steps for implementing the restoration opportunities identified here include the following:

- Coordinate with other city partners
- Prepare conceptual design and costs
- Obtain funding
- Obtain permits and begin environmental review
- Prepare final design, specifications, and costs
- Begin construction

2 INTRODUCTION

The goal of this project was to identify and prioritize future salmon habitat restoration opportunities at Seattle city parks that are consistent with the City of Seattle's (City's) salmon habitat and restoration strategy. The park properties evaluated in the project were those identified by the City with potential for utilization by juvenile salmon, under the control of Parks, and with some potential for habitat enhancement. A total of 35 parks were studied, including parks on Lake Washington, the Lake Union/Ship Canal to the Locks, and on Puget Sound/Elliott Bay. Parks not included in the study include the following: Green Lake, which does not support salmon; the new Herring's House Park, specifically designed for salmon habitat in the Duwamish River area; several other smaller sites determined too small for assessment (typically less than 50 feet in length). Fieldwork focused on data collection in the nearshore and littoral environment at these parks. In this report, we summarize the existing scientific information on the ecological functions of shoreline habitat for salmonids and the results of our assessment and prioritization of potential restoration and conservation areas.

3 LITERATURE REVIEW AND BACKGROUND INFORMATION

3.1 Definition and Importance of Littoral and Nearshore Environments

In this project, the freshwater littoral zone was defined to extend from the riparian corridor bordering the shoreline to a waterward boundary at ordinary high water (OHW –18.67 NGVD). The nearshore zone of focus for marine areas extended from the riparian corridor bordering the shoreline to the intertidal zone. These zones of focus encompass the shoreline area typically considered to be important for juvenile anadromous fish during their early life histories (e.g., Kurt Fresh, Washington Department of Fish and Wildlife (WDFW), personal communication; MacDonald et al. 1987).

The use of littoral and nearshore environments is important in the life history of anadromous salmonids (Simenstad 1983, Aitkin 1998, Williams and Thom 2001). All anadromous salmonids use these zones for some time during juvenile rearing, although each species utilizes these areas in different ways and to different extents. For example, chinook and chum salmon and cutthroat trout in nearshore areas tend to utilize these habitats for juvenile rearing more than other species (Dorcey et al. 1978; Simenstad et al. 1982; Healey 1982).

3.2 Salmonid Occurrence at Seattle City Parks

Many salmonids utilize shoreline park areas in Seattle, including chinook, coho, chum, pink, and sockeye salmon, and steelhead, coastal cutthroat, and bull trout. These fish migrate from various freshwater input areas to Puget Sound, including the Cedar River, the Duwamish and Green Rivers, the Sammamish Slough, and various smaller streams. Salmonids vary widely in life history strategy and temporal presence in the area; details on their use of the area are well documented elsewhere (e.g., Cedar River Habitat Conservation Plan, City of Seattle 2000).

3.2.1 Chinook Salmon

3.2.1.1 Freshwater

Three stocks of chinook salmon are present in Seattle park areas: (1) an Issaquah Creek stock, (2) a Cedar River stock, and (3) a north Lake Washington tributary stock. These fish are classified as threatened under the Endangered Species Act (ESA) as part of the Puget Sound chinook evolutionarily significant unit (ESU). The

Cedar River stock comprises the largest run of wild chinook in the Lake Washington Basin. Adult chinook salmon migrate through the Puget Sound to the Lake Washington system from July to October (Kurt Fresh, WDFW, personal communication; Tabor and Piaskowski 2002). Juveniles enter Lake Washington basin at two life stages; fry enter in February and March and smolts enter in April and May (Tabor and Piaskowski 2002). The early fry spend several months rearing in the lake, whereas the smolts spend 20 to 40 days before migrating to Puget Sound (City of Seattle 2001). During these periods of residence, both are heavily reliant on the littoral zone as habitat. Littoral zone areas most heavily utilized by chinook include areas around creek mouths and areas that are not heavily developed (GLWTC 2001).

3.2.1.2 Estuarine and Nearshore

Chinook salmon from the Duwamish/Green, Cedar, Skagit, and Nisqually Rivers utilize Seattle marine/estuarine park areas. The Cedar River stock migrates through the Hiram Chittenden Locks (Locks) from May to September (Tabor and Piaskowski 2002). Cedar River juveniles are smaller in comparison to salmonids from the Duwamish/Green Basin migrating in Puget Sound, so they are more dependent on estuarine and nearshore areas for growth (Levy and Northcote 1982; Pearce et al. 1982). These juveniles are abundant in the nearshore from January to September, and are present to an unknown extent all year (KCDNR 2001). While there are no published data on chinook residence times in nearshore areas of Puget Sound, among the fish discussed here, chinook are the most dependent on estuarine areas, residing in estuarine habitats up to 189 days (Wallace and Collins 1997; Levy and Northcote 1982).

3.2.1.3 Chinook Occurrence at Specific City Parks and Lake Areas

In 2001, Tabor and Piaskowski (2002) found juvenile chinook present in unexpected high abundance at Gene Coulon Park near the mouth of the Cedar River and at the mouth of Issaquah Creek. This is likely a function of the high numbers of chinook outmigrating from the Cedar River and the Issaquah Hatchery. Estimates of outmigrating juvenile chinook from the Cedar River ranged from approximately 29,000 to 79,000 fish from 1999 to 2001 (Seiler and Volkhardt 2001). WDFW's

Issaquah Creek hatchery has an annual production goal of releasing two million chinook juveniles each May into Issaquah Creek.

Chinook have also been captured in large numbers in 2001 at West Montlake Park and Gas Works Park (Tabor, unpublished data of WDFW sampling), whereas they were captured in smaller numbers at Beer Sheva and Seward Parks. Fish were observed at swim beaches in high abundance, but the majority of fish were associated with the vegetated areas adjoining the beach rather than the beach center.

Tabor (2003a) found that the abundance of chinook salmon displayed a strong, negative relationship with the shoreline distance from the mouth of the Cedar River. This was true for sites on the east and west shorelines of Lake Washington and Mercer Island. There was little difference between chinook juvenile densities at sites on Mercer Island and those on east and west lake shoreline sites that were similarly distanced from the mouth of the Cedar River.

3.2.2 Coho Salmon

Coho salmon (*Oncorhynchus kisutch*) in Seattle park areas are part of the Puget Sound/Strait of Georgia ESU and are a candidate species for listing under the ESA. Adult coho begin migrating to Lake Washington through the Ship Canal in August to November. After spending 18 months rearing in rivers before migration, juveniles are present in the littoral zone of the lake from April through June (Beauchamp, Univ. of Washington, unpublished data; Tabor and Chan 1996; Paron and Nelson 2001; GLWTC 2001). These juveniles are typically yearling smolts that have been rearing in tributaries or hatcheries upriver. Few fry and subyearlings have been caught in Lake Washington, suggesting that lake rearing in the first year of life is uncommon for these fish and their seaward migration is rapid (GLWTC 2001).

It is generally assumed that coho smolts migrate through Puget Sound estuarine and nearshore areas very quickly (GLWTC 2001). These fish are larger upon migration than other salmonids and are thought to prefer deeper, marine influenced habitats (Emmett et al. 1991).

3.2.3 Chum Salmon

Chum salmon (*Oncorhynchus keta*) are considered extinct in the Lake Washington system (GLWTC 2001). Existing Puget Sound chum salmon stocks utilizing Seattle park areas are fall-run fish, returning to their natal streams in October and November. Juvenile chum salmon migrate seaward immediately after hatching, and are present in nearshore areas of Puget Sound between January and July (KCDNR 2001). Among the fish discussed here, chum salmon are the second most dependent on estuarine and nearshore environments after chinook, spending from days to three months in these habitats (Pearce et al. 1982; Johnson et al. 1997).

3.2.4 Pink Salmon

Pink salmon (*Oncorhynchus gorbuscha*) are considered extinct in the Lake Washington system (GLWTC 2001). Most Puget Sound pink salmon in Seattle park areas are odd-year populations. Adult pink salmon are present in southern Puget Sound in July and August. Juvenile pinks move through Lake Washington and estuarine areas very quickly on their seaward migration. While present in Puget Sound from March through May, these fish use nearshore areas extensively for feeding and rearing (Hard et al. 1996)

3.2.5 Sockeye Salmon

Two life histories of sockeye salmon (*Oncorhynchus nerka*) are present in Seattle park areas. The majority of sockeye in the Lake Washington Basin are anadromous, spawning in freshwater, maturing in the ocean, while a small portion are residents, spawning, maturing, and dying in freshwater. Sockeye adults return to freshwater from May to August. Most of these return to the Cedar River for spawning, although some spawn in Lake Washington littoral areas (WDFW 1993). Juveniles are present in the lake for rearing after their emergence in January through June, while they migrate out of the lake between April and July (Paron and Nelson 2001; Gustafson et al. 1997). Following their emigration from the Cedar River into Lake Washington, some sockeye juveniles move directly to offshore areas of the lake, while others utilize the littoral zone for rearing for up to a month before moving to the deeper water of the limnetic zone (Martz et al. 1996). Their feeding behavior and growth in the limnetic zone has been studied (Eggers 1975), but the extent of their use of this zone is unclear (Martz et al. 1996). Sockeye juveniles rear in the lake for up to 18 months before migrating seaward,

and in doing so, move back from limnetic habitats to the littoral zone (GLWTC 2001). Once in the nearshore, sockeye utilize the nearshore to a much lesser extent than other salmonids (Hart 1973; Emmett et al. 1991; Gustafson et al. 1997).

3.2.6 Steelhead Trout

Steelhead trout (*Oncorhynchus mykiss*) are present in Seattle park areas as part of an ocean-maturing, or winter steelhead stock. These native steelhead typically rear in streams for two to three years and enter Lake Washington between January and May (Paron and Nelson 2001). Juveniles are present in littoral and nearshore marine areas in April and May during seaward migration (Fresh and Lucchetti 2000) and remain in estuarine or nearshore areas for a brief period before moving offshore. Even when they migrate to the ocean, steelhead may spend considerable time as juveniles or adults in the protected waters of Puget Sound (WDOE 2003).

3.2.7 Coastal Cutthroat Trout

Coastal cutthroat trout (*Oncorhynchus clarki clarki*) are present in Seattle park areas in both resident and anadromous forms. Adult cutthroat migrate through the Puget Sound in July to October prior to spawning in December through June (WDFW 2000; Pauley et al. 1989; Trotter 1989), while juveniles migrate seaward in April and May (Grette and Salo 1986). They are present in the nearshore, spending a range of times in estuaries. Some cutthroat trout may remain in nearshore/estuary waters most of their lives (WDOE 2003).

3.2.8 Bull Trout

The Coastal/Puget Sound population of bull trout (*Salvelinus confluentus*) were listed as threatened in November 1999 by the U.S. Fish and Wildlife Service (USFWS) (USFWS 1999a). Bull trout were originally classified with Dolly Varden (*Salvelinus malma*) under one scientific name, but were split into two distinct species in 1991. Differences in the distribution and life history of each species is not well known because the species are biologically similar and methods to separate them are new and not widely applied (Bonar 1997). There is no survey protocol currently endorsed by the USFWS for establishing absence of bull trout, so its presence is assumed where suitable habitat exists (USFWS 1999b).

Bull trout present in Seattle park areas are part of the Chester Morse Reservoir subpopulation (WDFW 1998). These fish have rarely been observed in the Lake Washington Basin; however, if present, these adults would migrate prior to spawning in August through November, and juveniles would emerge in April through May (Ratliff and Howell 1992). Little is known of the distribution and abundance of bull trout in Puget Sound estuaries and nearshore waters (KCDNR 2001).

3.3 Ecological Functions Provided by High-Quality Salmonid Habitat

Whether juvenile salmonids remain in the littoral and nearshore zones for six months or longer, or migrate rapidly through the area, they depend on one or more essential ecological functions that influence fish survival. Numerous studies have demonstrated the essential role of these functions in ecosystem sustainability and salmonid survival (Simenstad 1983; Spence et al. 1996; Williams and Thom 2001). These functions include:

- Prey Availability
- Predator Refuge
- Migration Corridors
- Physiological Refuge
- High Energy Refuge

Prey availability refers to the presence and production of an abundance of suitable and common prey items. Relative availability, or the ability of fish to capture these items, is not addressed here. Refuge from fish and avian predators involves the presence or absence of habitat features that allow fish to escape direct mortality while feeding and rearing in littoral and nearshore areas. Migration corridors refer to connected or continuous habitat suitable for juvenile salmonids during outmigration or rearing in littoral and nearshore areas. Habitat generally considered favorable for migration includes a gently sloping beach with no overwater structures to restrict light penetration of the water. Physiological refuge refers to the availability of less demanding water quality conditions. In Seattle park areas, juvenile salmonids face two main physiological challenges: the transition to saltwater and potentially high lake water temperatures. Juvenile salmonids encounter osmoregulatory challenges during their movement from fresh to salt water, which is exacerbated by the absence of an extended transition zone of increasing salinity at the Locks. Juvenile

salmonids exiting Lake Washington may seek tributary mouths as refuge habitats because overhead vegetated cover and the water from these tributaries provide refuge from higher salinities or temperatures. High energy refuge refers to the presence of low energy areas for fish feeding and rearing. High energy environments require increased energetic demand on fish; thus, these low-energy areas can be important in providing increased opportunity for growth, particularly among the small salmonid size classes.

3.3.1 Prey Availability

3.3.1.1 Freshwater

Juvenile salmon require habitat that provides and supports the production of ample prey resources, which includes unaltered shorelines with organic and small substrates. Juvenile chinook in Lake Washington prey on insects and pelagic invertebrates, namely chironomids and *Daphnia* spp. (Koehler 2002). Chironomids are found in significantly higher densities in organic substrates than in sand, small cobble, or cobble substrates. It is likely that chironomids are more abundant in organic substrates due to their tolerance of low dissolved oxygen conditions in the substrate as well as the availability of detritus for feeding (Koehler, pers. comm.).

3.3.1.2 Saltwater

Juvenile salmonids in Puget Sound feed on forage fish larvae and eggs as well as other pelagic, benthic, and epibenthic organisms from nearshore, intertidal, and eelgrass/kelp areas (Simenstad and Cordell 2000; Fresh et al. 1981). The densities of some of these prey taxa have been shown to play an important role in determining salmonid residence time and growth (Wissmar and Simenstad 1998; Simenstad et al. 1982).

Shoreline modification has been shown to influence benthic and epibenthic organisms. Some studies on the east coast have shown benthic macroinvertebrates to be more abundant in structurally complex estuarine shorelines than in bulkheaded areas (Watts 1987). In the nearshore of Puget Sound, the presence of ferry terminals negatively affects the abundance of epibenthic juvenile salmon prey living under and near terminals (Haas 2001).

Shoreline armoring, the removal/destruction of marine riparian vegetation, and the presence of artificial outfalls can disturb forage fish spawning and inhibit the formation of this habitat. Small substrates (1 to 7 mm) are crucial for successful forage fish spawning and rearing (Lemberg et al. 1997; Penttila 2001). It is thought that shoreline armoring contributes to the loss of beach substrates supporting spawning activities (Thom and Hallum 1990; Thom and Shreffler 1996). In addition, marine riparian vegetation is important to forage fish spawning (Penttila 2001), egg survival (Robards 1999), and intertidal invertebrate distribution (Foster et al. 1986; Simenstad and Cordell 2000). Stormwater and combined sewer outfalls (CSOs) supply excess or toxic chemicals to the shoreline and may interfere with habitat processes related to shoreline spawning.

3.3.2 Refuge

3.3.2.1 Freshwater

Juvenile salmonids require habitat that provides refuge from predatory, physiological, and high-energy challenges; these considerations have been combined in this discussion because of overlapping relevancies. High-quality refuge habitat, limited in Lake Washington and the Ship Canal (Tabor and Piaskowski 2002; Weitkamp et al. 2000), consists of unarmored, shallow-gradient littoral zone with large woody debris (LWD) and overhanging vegetation (Tabor and Piaskowski 2002; Eggers 1978). Low-quality refuge habitat is prevalent in most Seattle city shoreline areas due to shoreline development, lack of LWD, and the proliferation of exotic predatory fish species.

Shoreline modifications that preclude shallow-water habitat comprise most of the Lake Washington shoreline within Seattle city limits (Parametrix and NRC 1999; Toft 2001). In other lakes, shoreline modifications have been found to increase habitat for juvenile chinook salmon (Beauchamp et al. 1994) but they may enhance habitat for predatory species such as bass (Bryan and Scarnecchia 1992). In Lake Washington, pilings and riprap likely contribute to increased energy expenditure and risk of predation on juvenile salmonids by small- and largemouth bass (Stein 1970; Pflug 1981; Pflug and Pauley 1984; Ruggerone 1995). Riprap areas have been shown in other lakes to exhibit higher water velocities, depths, and steep slopes compared to

unaltered habitats (Garland et al. 2002). Due to littoral zone activities and modifications, including dredging, filling, bulkheading, and construction, very little native vegetation remains on the Lake Washington shoreline (Weitkamp et al. 2000; Toft 2001).

The role of LWD in providing predation or high energy refuge in freshwater City park habitats likely depends on several factors, including juvenile salmonid feeding activity, time of day, and season (Tabor and Piaskowski 2002). In Lake Washington and Lake Sammamish studies, chinook salmon did not appear to strongly prefer woody debris (Tabor and Piaskowski 2002). The authors found that one group of Lake Sammamish juvenile chinook used LWD for resting, while another group foraged offshore. In addition, predatory bass used LWD habitats with overhanging vegetation beginning in May and June and chinook use of these habitats decreased accordingly. Peters (1996) found that juvenile coho in the Clearwater River in western Washington strongly selected for LWD habitats at a large scale, but showed no selection at finer scales. There is some concern that Eurasian watermilfoil, prevalent in Lake Washington and Union Bay, enhances piscivorous predator habitat (Weitkamp et al. 2000). This plant has been associated with increased abundance of the predatory northern pikeminnow in a British Columbia Lake (Gregory and Levings 1993).

3.3.2.2 *Saltwater*

Refuge is limited at Seattle parks near the fresh/saltwater transition at the Locks due to the limited natural habitat and sharp osmotic gradient. Warner and Fresh (1999) suggested that this swift physiological transition increases osmotic stress on fish upon their saltwater entry. In addition, it has been suggested that substantial predation by birds (Martz et al. 1996) occurs at the Locks. In nearshore marine areas, shallow nearshore areas, aquatic and marine riparian vegetation, LWD, and larger substrates are considered high quality refuge habitat (City of Seattle 2001). In Puget Sound, this habitat is limited due to the prevalence of bulkheads and overwater structures, and extensive filling, dredging and grading in shoreline areas (Weitkamp et al. 2000; City of Seattle 2001).

3.3.3 Migratory Corridors

3.3.3.1 Freshwater

Juvenile salmonids require habitat with few barriers to their seaward migration. Lake Washington lacks these barriers, but concern exists among biologists that overwater structures such as docks and piers may indirectly act as a barrier to alter migration patterns (Weitkamp et al. 2000). Juvenile salmon readily pass under small docks and narrow structures under which darkness is not complete, but will not pass under large overwater structures with dark shadows (Dave Pflug and Don Weitkamp, pers. comm. in Weitkamp et al. 2000). To date, this potential effect has not been investigated further in Lake Washington (Weitkamp et al. 2000).

3.3.3.2 Saltwater

The migratory corridor is severely modified at the Locks, as the fresh- to saltwater transition occurs rather abruptly within the salt wedge and mixing zone near the Locks. Options for fish passage include a fish ladder for large fish, a fish slide (primarily for smaller fish), and the water of the Locks themselves. However, the Locks remain problematic because of the high rate of injury, including scale loss (Seiler 1996; Smith 1982).

In nearshore areas of the Duwamish Estuary and Elliott Bay, several studies have shown that unlike Lake Washington docks and piers, overwater structures in the Duwamish and Elliott Bay do not have a detrimental effect on juvenile salmonid migration patterns, but this has been attributed to the difference in size and construction from similar structures along Lake Washington and Lake Union shorelines (Weitkamp et al. 2000). However, some studies have shown that drastic changes in ambient underwater light environments may alter fish migration behavior and increase mortality (Nightingale and Simenstad 2001).

3.4 Summary of High Quality Habitat Characteristics

High quality habitat for juvenile salmonids in Lake Washington and Lake Union are characterized by fine-grained substrates, shallow gradients, overhead cover, unarmored banks, and no barriers to migration (Tabor and Piaskowski 2002; City of Seattle 2001). High quality habitats in Lake Union and the Ship Canal are similar to those in Lake Washington,

but include limited barriers to migration (City of Seattle 2001). Favorable habitat in Puget Sound is similar to that in freshwater areas, but also includes eelgrass beds, marine riparian vegetation, and diverse substrate types (City of Seattle 2001). From a landscape ecology perspective, the spatial distribution of refuge, cover, and food, as well as connectivity between and among habitats is important in Lake Washington, Lake Union/Ship Canal, and Puget Sound.

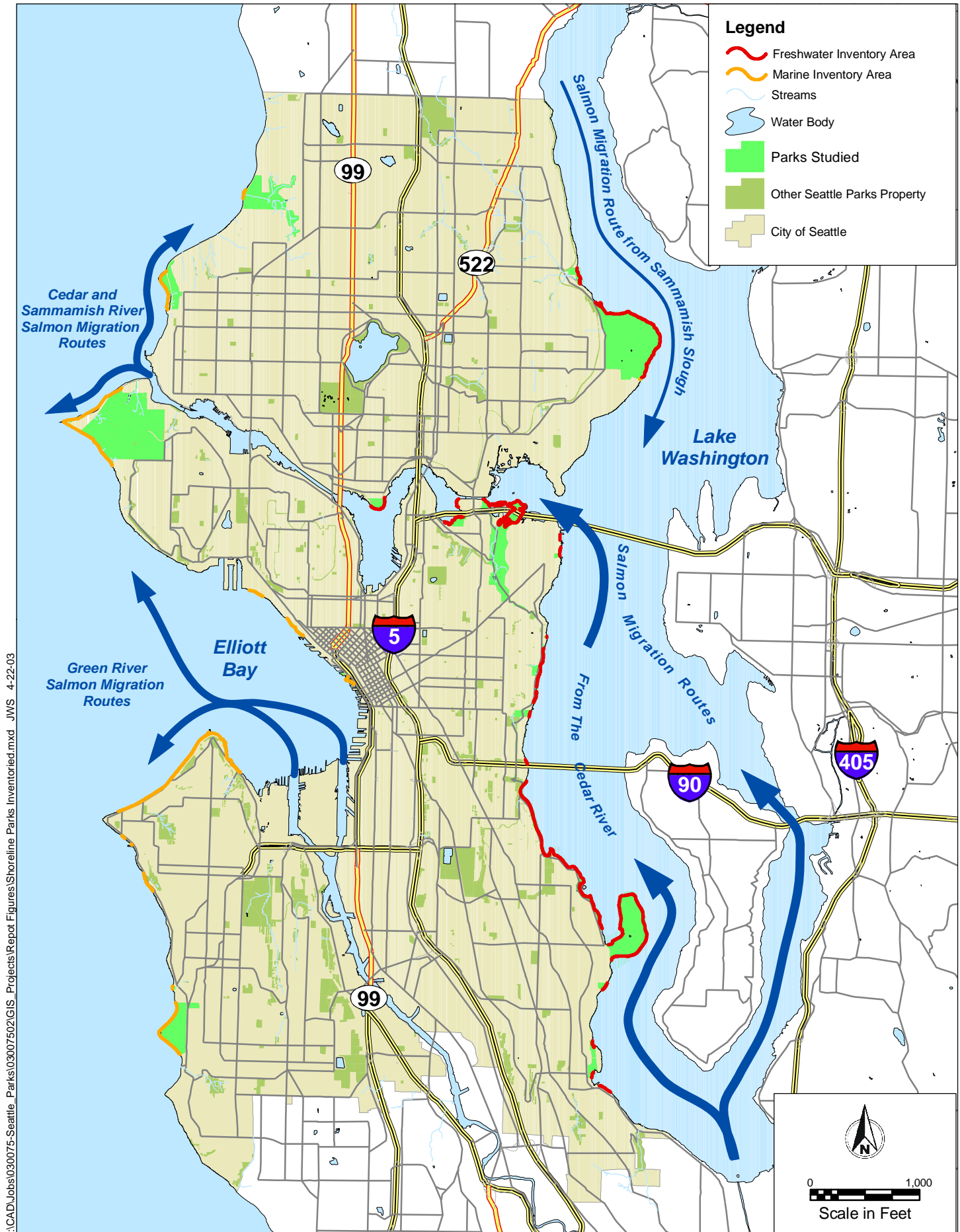
4 APPROACH AND PRIORITIZATION METHODS

4.1 Project Objective and Approach

The overall goal of this project was to inventory Parks shoreline properties and assess their suitability and relative priority for juvenile salmonid habitat restoration and enhancement. Our approach included a consideration of the current park uses. The park properties evaluated in the project were those identified by the City with potential for utilization by juvenile salmon, under the control of Parks, and with some potential for habitat enhancement. These properties included 18 parks on Lake Washington, four parks on Lake Union/Ship Canal to the Locks, and 13 parks on Puget Sound/Elliott Bay, totaling 35 parks. All of these parks are positioned along juvenile salmonid migration routes, and collectively encompass approximately 23 miles of shoreline with individual park shorelines ranging from 150 feet to 14,500 feet (Figure 1). The study did not include sites on other lakes, such as Green Lake, that are not utilized by salmon, or creeks under the management of entities other than Parks. Fieldwork was conducted focusing on data collection in the nearshore environment at these parks.

Our approach was based upon the links between habitat features and the ecological functions the features provide to meet salmonid needs. The habitat features comprising the conditions that salmonids encounter determines whether their needs are met. In this way, the site-specific ecological functions of habitats necessary for salmonid survival were characterized based on the habitat features.

In addition to the site-specific observation of habitat features and conditions, a broader landscape ecology perspective is important for prioritizing habitat restoration opportunities (Simenstad and Cordell 2000). For this project, the broader perspective was useful for fitting existing conditions and potential habitat restoration opportunities into the overall habitat setting that littoral and nearshore zones provide. Landscape perspective considerations included park locations in relation to known use areas (e.g. Cedar River), forage fish spawning areas, and locations relative to known rearing areas/tributary streams.



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Also, current recreational park uses were considered in restoration prioritization, including pedestrian trails, boat ramps, visual shoreline access, and swimming beaches. Restoration opportunities were evaluated relative to the feasibility of implementing projects at these parks, based on the opportunities and constraints posed by park uses.

4.2 Methods

4.2.1 Literature Review

Relevant studies and data sets, including current scientific and agency literature, were reviewed to identify salmonid use of the project area and important habitat functions and requirements for juvenile salmonid habitat. (See Literature Review, Section 3).

4.2.2 Field Data Collection

Based upon the links between habitat conditions and ecological function, we characterized the status of habitat functions at shoreline parks using information on a suite of habitat parameters. For parks in freshwater areas, these parameters included shoreline slope, stream location and type, substrate, vegetative cover and type, LWD presence and depth, overwater structures, and shoreline armoring and depth. For parks in Puget Sound, we also included the shoreline's value as forage fish habitat. Table 1 lists the habitat parameters collected and shows which habitat functions were affected by each habitat parameter.

Table 1
Essential Habitat Functions and Habitat Parameters Collected at Seattle City Parks

Habitat Parameters Collected	Freshwater Function	Estuarine and Marine Function	Details
Shoreline Slope	A, P, M	A, P, M	<ul style="list-style-type: none"> Shallow-gradient littoral zones provide refuge from deeper-water predators and opportunities for feeding and migration.
Stream Location and Type	A, Ph, M	A, Ph, M	<ul style="list-style-type: none"> Juvenile salmonids exiting Lake Washington may seek tributary mouths because they provide refuge from high temperatures or low dissolved oxygen. Terrestrially-derived prey resources may occur here. Adult salmonids pass tributary mouths to migrate to spawn; juvenile salmonids migrate from tributary mouths to Lake Washington.

Habitat Parameters Collected	Freshwater Function	Estuarine and Marine Function	Details
Substrate	A, P	A, P	<ul style="list-style-type: none"> In freshwater areas, fine substrates support the production of insect and forage fish prey resources. Organic substrates support higher densities of certain abundant chinook prey. In nearshore areas, cobble substrates provide predation refuge habitat.
Vegetation Cover Percent and Type	A, P, Ph, M	A, P, Ph, M	<ul style="list-style-type: none"> Overhead vegetative cover supports the production of insect and forage fish prey resources. Overhanging vegetation provides temperature and predator refuge, especially important for feeding and migration opportunities.
LWD Numbers and Depth	A, P, Ph	A, P, Ph	<ul style="list-style-type: none"> In freshwater areas, LWD provides temperature and predator refuge, up to a certain depth, after which predation by bass becomes a concern. Fish return to LWD for refuge during foraging. In marine/estuarine areas, LWD is assumed to provide similar refuge functions, but this has not been studied broadly.
Presence and Size of Overwater Structures	A, P, M	A, M	<ul style="list-style-type: none"> Docks and piers in Lake Washington may act as a barrier to migration, alter feeding behavior, and may provide habitat for predators. Overwater structures in the nearshore have not been proven to affect fish predation risk, but they may affect fish habitat preferences wherein drastic changes in ambient underwater light environments may alter fish migration behavior and increase mortality. Ferry terminals in the nearshore affect juvenile salmon prey abundance.
Shoreline Armoring Presence, Type and Depth	A, P, E	A, P, E	<ul style="list-style-type: none"> Unarmored shorelines are crucial to prey production and forage fish spawning and rearing; armoring contributes to the loss of beach substrates supporting these activities. Riprap contributes to increased energy expenditure by increasing velocities, depths, and steepness of shoreline slopes. Bulkheads contribute to deep-water habitat suitable for predators.

Notes:

- A: Parameters which affect prey availability
 P: Parameters which affect predator refuge
 Ph: Parameters which affect physiological refuge
 E: Parameters which affect high energy refuge
 M: Parameters which affect migration corridors

Each park was divided into a series of reaches based on major changes in any of the above parameters. For example, if the first reach of a park was dominated by an area of riprap bulkhead and invasive vegetation, the point at which the bulkhead and/or vegetation ended would signify the end of that reach and the beginning of a new reach. Each reach was then characterized according to the above noted functions.

Geographic location and habitat parameter data were collected for each reach of each park. Location data was collected with a Trimble Pro XR Global Positioning System (GPS) and was differentially corrected following field data collection. Information on habitat parameters was collected using an electronic datalogger, and was imported into Microsoft Excel. Two different data dictionaries were used for data collection, one for freshwater habitats and one for marine habitats (Appendix A). Location data and attribute tables of habitat parameter data were imported and managed in *ESRI Arc GIS* (ESRI 2002).

4.2.3 Restoration Prioritization and Identification of Conservation Reaches

Reach restoration priorities were systematically determined using a GIS database and scoring system that was based on habitat features, landscape considerations, and park uses (Figure 2).

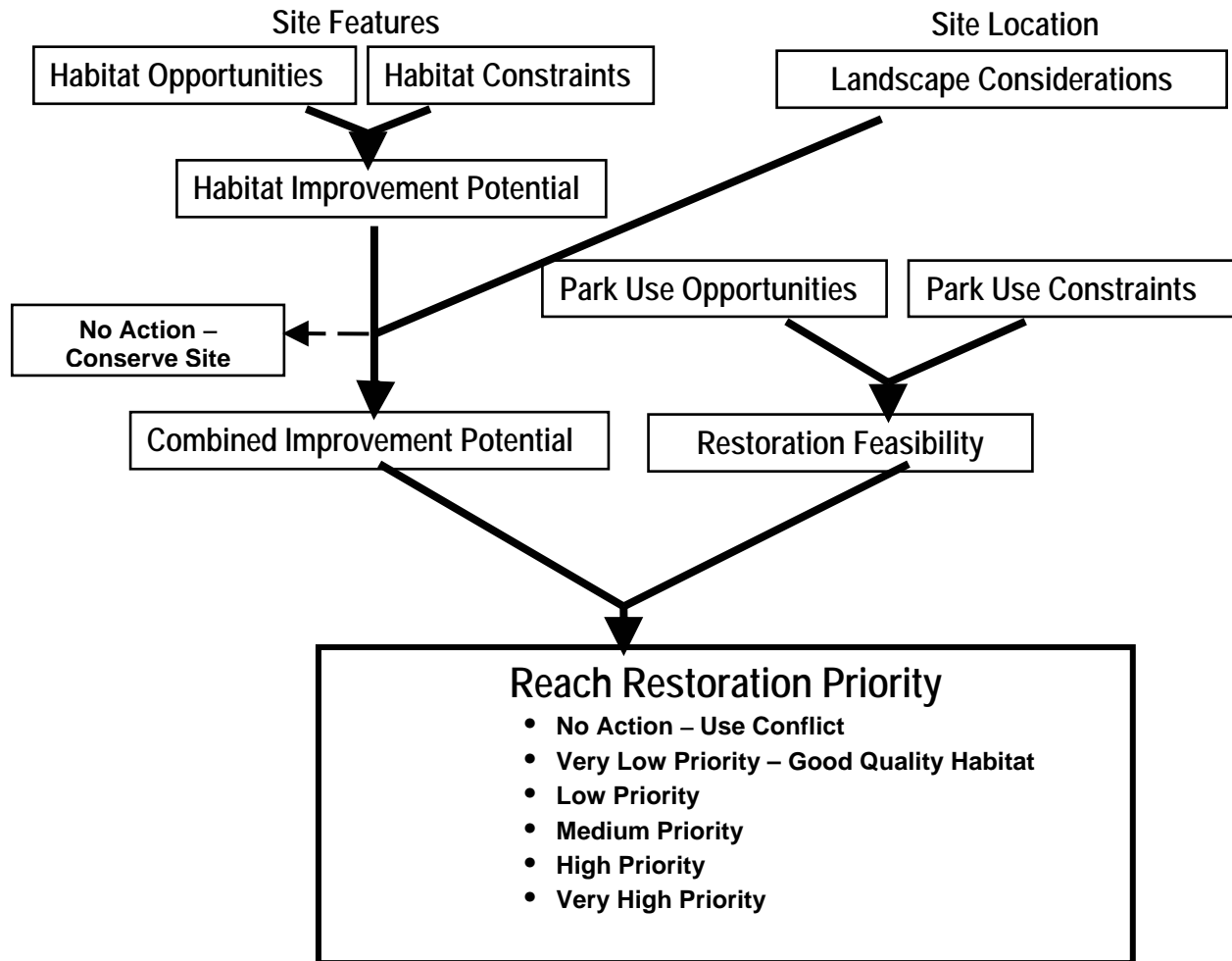


Figure 2
Restoration Prioritization Scoring System

We used this scoring system to assign a Reach Restoration Priority to each reach, using a set of decision rules for each consideration affecting prioritization (Appendix B). The following process was followed for each reach:

- Assigned each habitat parameter for each reach a ranking of *low*, *medium*, or *high* by evaluating each parameter's habitat value based on the information from scientific and public literature (Appendix C).
- Summarized the habitat of the reach into a Reach Condition.
- Identified Habitat Restoration Opportunities based on the Reach Condition.

- Identified Habitat Constraints which would prevent or compromise restoration efforts from a habitat perspective (e.g. removal of concrete seawall could lead to shoreline erosion).
- Assigned a Habitat Improvement Potential (*low, medium, high*) ranking based on the amount the reach habitat could improve by implementing the Habitat Restoration Opportunities, where a ranking of *low* meant the habitat would improve very little, and a ranking of *high* meant the habitat would undergo significant improvement with restoration. Generally, habitat with only one opportunity, such as removing invasive vegetation, received a *low* ranking, while habitat with multiple opportunities such as bulkhead removal, slope adjustment, and revegetation received a *medium* ranking. Docks, marinas and severely impacted habitats received a *high* ranking.
- Took landscape perspective into account based on the decision rules and assigned each park a *high, medium, or low* Landscape Consideration ranking.
- Considered Landscape Consideration with Habitat Improvement Potential to assign a Combined Improvement Potential ranking of *very low, low, medium, high, or very high*, where *very low* meant that the habitat would improve very little, and a value of *very high* meant the habitat would undergo very significant improvement with restoration.
- Formulated a narrative of comments and recommendations for reaches with significant value for conservation by identifying the location(s) within the park with high quality habitat. This was done to emphasize the value of these reaches as high quality habitat separate from reaches that merit consideration for restoration.
- Identified Park Use Opportunities based on how much flexibility exists in implementing the Habitat Restoration Opportunities (e.g., removal of a recreational boat ramp may be highly unlikely, while removal of shoreline armoring in certain reaches may have be possible).
- Identified Park Use Constraints which would prevent or compromise restoration efforts from a Parks perspective (e.g., vegetation plantings to increase overwater cover cannot occur along the shore of a swim beach).
- Used Park Use Opportunities and Constraints to assign a Restoration Feasibility ranking of *feasible, moderately feasible, or constrained*.

- Considered Restoration Feasibility with Combined Improvement Potential to assign a Reach Restoration Priority ranking of one of the following: *no action – use conflict; very low priority – good quality habitat; low priority; medium priority; high priority; very high priority; or no action – conserve excellent quality habitat.*
- Formulated a narrative Justification and Restoration Prescription for each park based on the Reach Restoration Priority rankings for the reaches comprising each park.
- Identified specific parks for restoration and conservation opportunities based on Reach Restoration Priority ranking (See Results in Section 5).

5 RESULTS

Priorities for restoration and conservation for specific parks varied within and among parks that were assessed. From the list of all parks considered, five parks were chosen for restoration opportunities, and 13 parks were identified with conservation value (Figure 3). The following is a discussion of the parks meriting consideration of these actions.

5.1 Restoration Sites

A wide array of restoration priorities was identified for inventoried parks. Several parks contained a range of priority rankings from the highest to the lowest priorities; this range is shown in Table 2. Three parks contained reaches identified as *very high restoration priority*:

- Rainier Beach Lake Park
- Beer Sheva Park
- Martha Washington Park

The following parks contained reaches identified as *high restoration priority*:

- Pritchard Island Beach
- Seward Park
- Colman Park
- Leschi Park
- Washington Park Arboretum
- Sand Point Magnuson Park
- North Shore Recreation Area
- Matthews Beach

Rankings for the remainder of the parks are given in spreadsheet detail in Appendix D and are shown on maps in Appendix E.

Table 2
Range of Reach Restoration Priorities Identified for Seattle City Shoreline Parks^a

Park Name	Very High Priority	High Priority	Medium Priority	Low Priority	Very Low Priority – Good Quality Habitat	No Action – Use Conflict	No Action – Conserve Excellent Quality Habitat
Rainier Beach Lake Park*	x			x			
Beer Sheva*	x			x		x	
Martha Washington*	x			x			
Pritchard Island Beach*		x			x		
Seward Park*		x		x		x	
Lake Washington Boulevard Parks (combined)		x		x		x	x
South Day Street			x		x		
Leschi South Moorage						x	
Leschi		x	x		x	x	
Madrona			x			x	
Howell						x	
Madison					x	x	
Madison North Beach						x	
Washington Park Arboretum		x			x		
East Montlake						x	x
West Montlake						x	
Montlake Playfield					x		
North Shore Recreation Area		x	x			x	
Sand Point Magnuson		x			x	x	
Mathews Beach		x		x			x
Gasworks						x	
Carkeek						x	
Golden Gardens				x		x	
Discovery						x	x
Myrtle Edwards						x	
Seattle Aquarium Waterfront						x	
Alki						x	
Seacrest			x		x	x	
Richey Viewpoint						x	
Cormorant Cove						x	
Emma Schmitz						x	
Lincoln			x			x	
Lowman Beach			x			x	

*Top five parks for restoration

^a Multiple rankings for each park are shown because each reach has its own ranking



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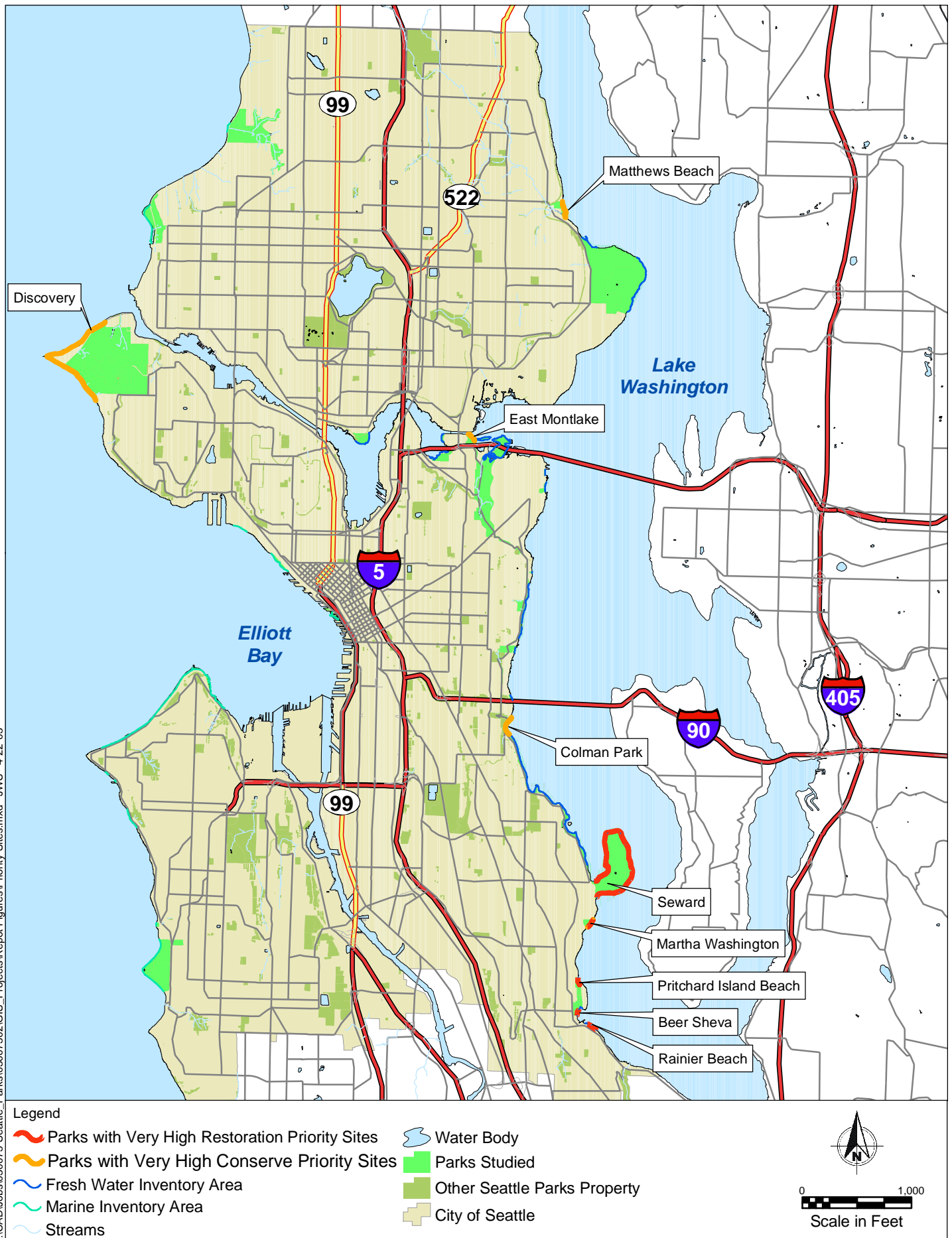


Figure 3
 Highest Priority Restoration and Conservation Sites
 Seattle Shoreline Park Inventory and Habitat Assessment
 Seattle Parks and Recreation

From the list of parks considered, five of the highest priority sites were chosen for further restoration opportunities. Three of these parks contained reaches ranked as *very high priority*: Rainier Beach Lake Park, Beer Sheva Park, and Martha Washington Park. Two more parks, Seward Park and Pritchard Island Beach, were chosen based on two factors: 1) they contained reaches with a *high priority* ranking and, 2) they have substantial potential to contribute to juvenile salmonid habitat based on known fish use areas relative to the Cedar River. Applying the identified prescriptions to these parks would address each of the functions documented as necessary for juvenile salmonid survival in nearshore areas. The following is a discussion of the conditions, restoration prescriptions, and restored functions at these top five parks. Additional details for restoration prescriptions are given in drawings in Appendix F.

5.1.1 Rainier Beach Lake Park

5.1.1.1 Current Reach Conditions

Rainier Beach Lake Park, located in south Lake Washington, contains two reaches that differ greatly from one another in habitat quality and value. The southern reach (reach 32) can be characterized by an unarmored, undeveloped, steep slope leading into a gentle slope at water level, with fine substrate high in organic detritus and abundant native overhead cover (Figure 4). Juvenile chinook salmon have been documented in high abundance in this specific reach (Roger Tabor, U.S. Fish and Wildlife Service, personal communication 2003b). The northern reach (reach 33) contains a small marina with a vertical concrete slab bulkhead fringing the shoreline.

5.1.1.2 Reach Restoration Priorities and Restoration Prescription

Restoration priorities Rainier Beach Lake Park indicated a *low priority* for reach 32 and a *very high priority* for reach 33 (Figure 4). The restoration prescription for this park includes a suite of changes aimed at removing the shoreline modifications that interfere with high quality salmon habitat (Figure 5). These changes for reach 32 include removing the marina and concrete slab bulkhead, regrading the shoreline to a gentle slope, and placing additional fine-grained substrate in the regraded area. Also, invasive vegetation could be removed and native overhanging vegetation could be added to increase overhead cover. In reach 33, any remaining invasives

could be removed and the remainder of the habitat can be conserved as part of an already functioning area (see Section 4.2).

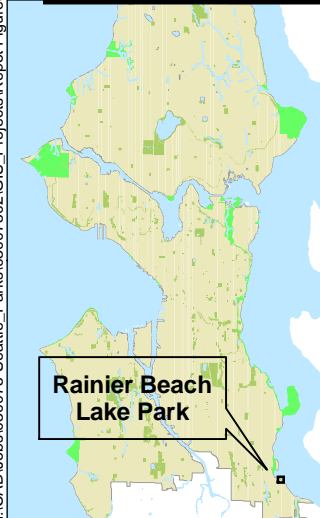
5.1.1.3 Restoration of Ecological Functions for Juvenile Salmonid Habitat

A restoration project at this park would address all of the five functions identified as important for salmonid habitat in littoral areas: Prey Production, Predator Refuge, Physiological Refuge, High Energy Refuge, and Migratory Corridors (Section 2.3). By planting native vegetation, the connection between terrestrial and aquatic habitats would be renewed, with the potential to increase prey production by restoring detritus delivery to the substrate. Also, the addition of overhanging vegetation would provide refuge from predators and provide localized areas of favorable light and temperature conditions. Removal of the concrete wall and pilings associated with the marina would decrease energy demand on juvenile salmonids in the restored habitat by decreasing water depth and velocity at the shoreline. In addition, restoring a high-quality habitat at this park would create a more optimal migration corridor and increase connectivity between habitats along southwest Lake Washington shoreline available for juvenile salmon migration.

5.1.2 Beer Sheva Park

5.1.2.1 Current Reach Conditions








Atlantic City Boat Ramp/Beer Sheva Park contains four reaches, three of which have similar habitat features (reaches 35, 37, 38) and one which contains a boat launch (reach 36). Generally, this park can be characterized as having a gentle slope with fine substrate, riprap or debris armor, and a high amount of cover from overhanging native vegetation (Figure 6). The existing six-ramp public motorized boat launch is popular for year-round water access. Anticipated changes to this park include a plan for 2004 to reduce this launch from six to four ramps and improve nearby habitat on the south end of this reach. In addition, there are potential plans for Seattle Public Utilities to collaborate on daylighting Mapes Creek north of the boat launch.



Rainier Beach Lake Park Priority Restoration Site

Legend

Restoration Priority

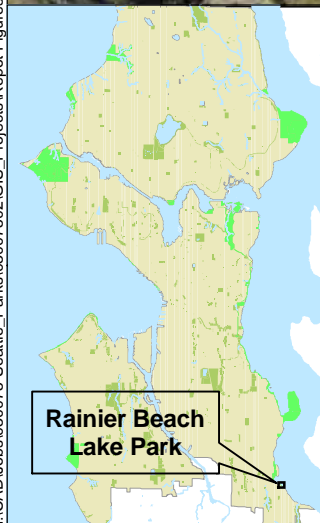
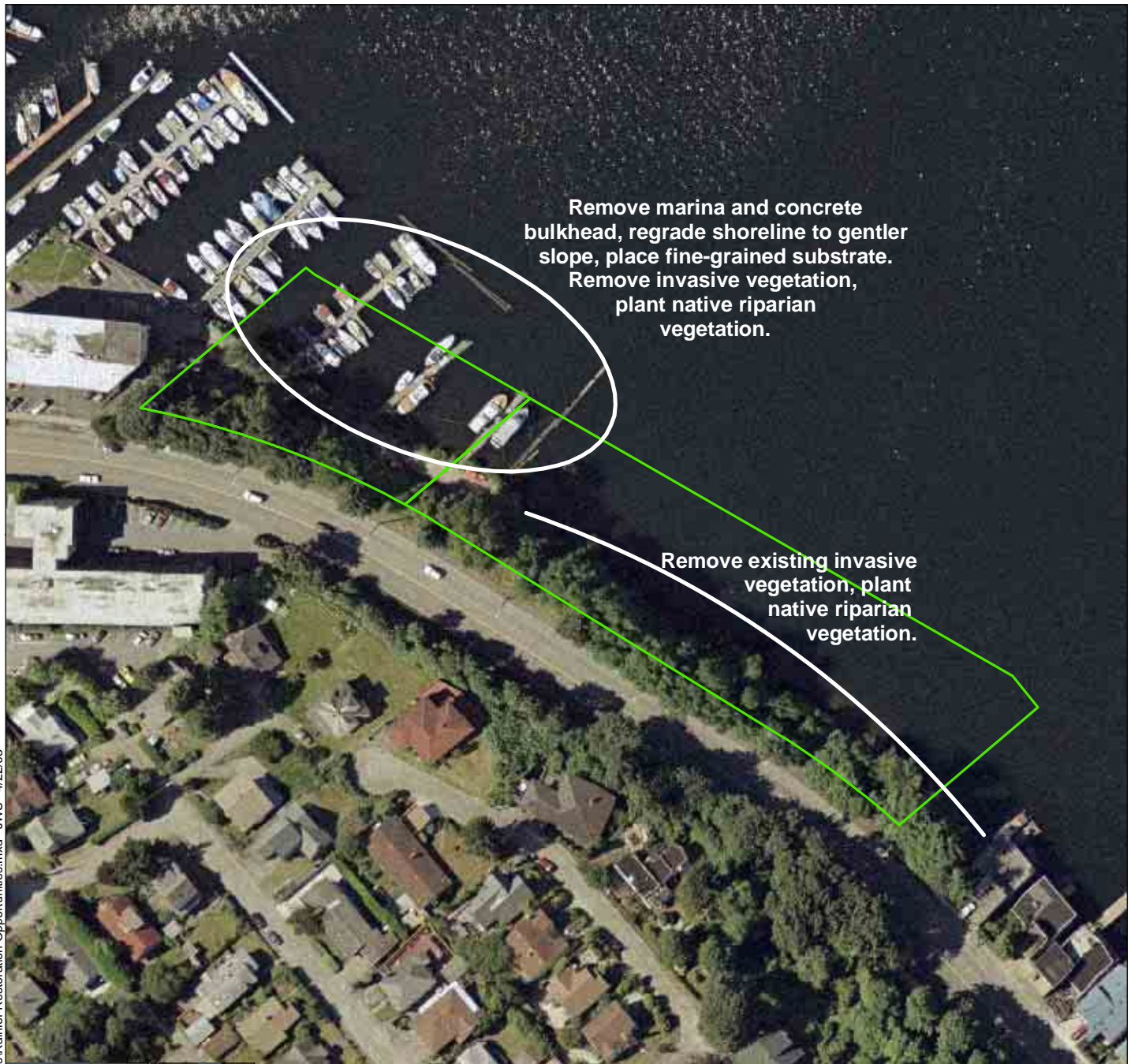
-  No Action - Conserve - Excellent Quality Habitat
-  Very Low Priority - Good Quality Habitat
-  Low Priority
-  Medium Priority
-  High Priority
-  Very High Priority
-  No Action - Use Conflict
-  City Parks



0 500 Feet

Figure 4

Rainier Beach Lake Park Reach Rankings
Seattle Shoreline Park Inventory and Habitat Assessment
Seattle Parks and Recreation



Rainier Beach Lake Park Priority Restoration Site

Restoration Opportunities

- Remove Overwater Structures
- Remove Bulkhead
- Create Gently Sloping Shoreline
- Place Fine Grained Beach Substrate
- Control Invasive Species
- Enhance Riparian Vegetation

Legend

 City Parks



0 500
Feet



5.1.2.2 Reach Restoration Priorities and Restoration Prescription

Restoration priorities for Beer Sheva Park indicated a *very high priority* for the reach north of the boat launch (reach 37), *no action – use conflict* for the boat ramp itself (reach 36), and *low priority* for the reaches at the park ends (reaches 35 and 38, see Section 4.2) (Figure 6). This indicates that the area adjacent to the boat launch could benefit most from restoration actions, and that habitat at the reach ends could be improved from its current armored condition. Specific restoration opportunities for the boat launch vicinity include proceeding with narrowing the launch area, removing riprap armor, removing any invasive vegetation that may exist, and planting native vegetation for more overhanging cover in the reach adjacent to the boat launch (Figure 7). At the park ends, the sparse riprap and concrete debris could be removed. Additional native vegetation could be planted, maintaining periodic shoreline view corridors where possible. In reach 38 at the north end of the park, Mapes Creek could be daylighted to provide a more natural creek outlet and additional creek mouth habitat.

5.1.2.3 Restoration of Ecological Functions for Juvenile Salmonid Habitat

Similar to Rainier Beach Lake Park, the above restoration project at Beer Sheva Park would address all of the five functions identified as important for salmonid habitat in littoral areas: Prey Production, Predator Refuge, Physiological Refuge, High Energy Refuge, and Migratory Corridors (Section 2.3). Increasing the amount of native vegetation at the shoreline would address prey production by increasing detritus delivery to the substrate. Also, the addition of overhanging vegetation could provide refuge from predators and provide localized areas of favorable light and temperature conditions. Riprap and concrete debris removal would decrease energy demand on juvenile salmonids in the restored habitat by decreasing water depth and velocity at the water's edge. Parks' plans to reduce boat launch area would both decrease overwater coverage (docks) and increase habitat connectivity within the park for juvenile salmon migration. In addition, the daylighting of Mapes Creek by Seattle Public Utilities would restore small creek mouth habitat important to juvenile salmon (Tabor 2003a).



Beer Sheva Park Priority Restoration Site

Restoration Opportunities

Reduce Overwater Structures
Remove Bulkhead
Control Invasive Species
Enhance Riparian Vegetation

Legend

 City Parks



0 500
Feet

Figure 7

Beer Sheva Park Restoration Opportunities
Seattle Shoreline Park Inventory and Habitat Assessment
Seattle Parks and Recreation

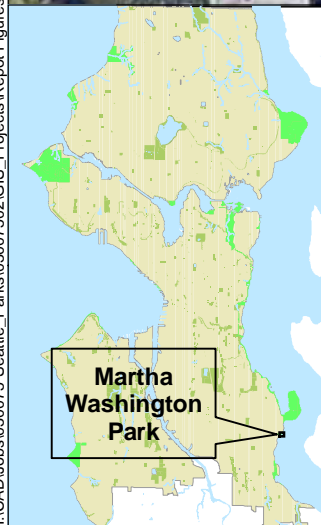
5.1.3 Martha Washington Park

5.1.3.1 Current Reach Conditions

Martha Washington Park's three reaches include one with adequate habitat features and two with substantial restoration need. The southern unarmored reach (reach 41), has a moderately steep slope, fine grained substrate, native vegetation, and an area of recent revegetation (Figure 8). The middle reach (reach 42) contains areas of riprap armor, groins, and two small pocket beaches. Its vegetation is a mixture of invasive and non-native plants which provide little cover, including Himalayan blackberry and turfgrass. Reach 43 is armored by a vertical riprap and stacked rock wall and includes abundant overhanging tree cover and large gravel/cobble-sized, detritus-covered substrates.

5.1.3.2 Reach Restoration Priorities and Restoration Prescription









Restoration priorities for this park indicated a *low priority* for the southernmost reach (reach 41, see Section 4.2), and *very high priority* for the other two reaches (reaches 42 and 43) (Figure 8). This indicates that the northern reaches would benefit most from restoration, and that habitat at the southernmost reach could be conserved in its present condition. At the northern reaches, the slope could be adjusted to a gentler grade, adding fine-grained substrate where necessary (Figure 9). Restoration could also remove as much riprap and rock as possible, except those rocks where removal would undermine the large cottonwood trees fringing the shore. Here, shoreline edges could be "scaloped" to accommodate these trees and to promote habitat diversity. Native vegetation could be added where possible to provide cover, including segments with shorter vegetation to maintain shoreline view corridors.



Martha Washington Park Priority Restoration Site

Legend

Restoration Priority

-  No Action - Conserve - Excellent Quality Habitat
-  Very Low Priority - Good Quality Habitat
-  Low Priority
-  Medium Priority
-  High Priority
-  Very High Priority
-  No Action - Use Conflict
-  City Parks



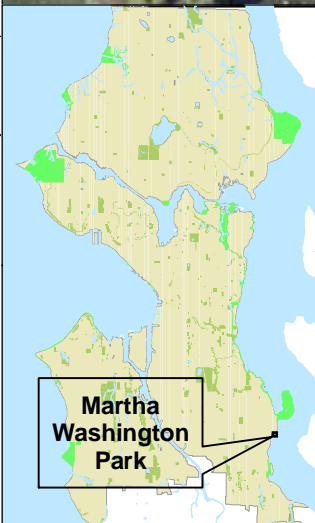
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Figure 8
Martha Washington Park Reach Rankings
 Seattle Shoreline Park Inventory and Habitat Assessment
 Seattle Parks and Recreation



Regrade shoreline to gentle slope, add fine grained beach substrate, remove riprap and rock armor scallop shoreline edge to enhance habitat diversity, plant native vegetation

Avoid damaging large cottonwood trees.



Martha Washington Park Priority Restoration Site

Restoration Opportunities

- Remove Bulkhead
- Create Gently Sloping Shoreline
- Place Fine Grained Beach Substrate
- Control Invasive Species
- Enhance Riparian Vegetation

Legend

 City Parks



0 500 Feet

5.1.3.3 Restoration of Ecological Functions for Salmonid Habitat

Similar to parks discussed previously, the above restoration project at Martha Washington Park would address all of the five functions identified as important for salmonid habitat in littoral areas: Prey Production, Predator Refuge, Physiological Refuge, High Energy Refuge, and Migratory Corridors (Section 2.3). Increasing the amount of native vegetation at the shoreline would address prey production by increasing detritus delivery to the substrate. Also, overhanging vegetation would provide refuge from predators and provide localized areas of favorable light and temperature conditions. Removing riprap would promote decreased energy demand on juvenile salmonids in the restored habitat by decreasing water depth and velocity at the water's edge. Restoring this park in conjunction with the other parks in this area would increase connectivity between known juvenile salmon migration corridors on the shoreline of southwest Lake Washington.

5.1.4 Pritchard Island Beach

5.1.4.1 Current Reach Conditions









Pritchard Island Beach has two reaches which differ from one another in habitat features and quality. The southern reach (reach 39), is characterized by a gentle slope with anchored logs, a small substrate, and mixed grasses and turf with no vegetative cover (Figure 10). There are also several boulders spaced in the littoral area. The northern reach (reach 40) contains the swim beach, which has a vertical concrete wall behind the swimming area. It has a small sandy substrate, and the turfgrass vegetation behind the beach provides no cover. Fish research in Lake Washington has identified abundant juvenile salmon use of swim beaches like this one; however, the public generally uses swim beaches most heavily in the summer after the majority of juvenile salmon have migrated through the area.



Pritchard Island Beach Priority Restoration Site

Legend

Restoration Priority

-  No Action - Conserve - Excellent Quality Habitat
-  Very Low Priority - Good Quality Habitat
-  Low Priority
-  Medium Priority
-  High Priority
-  Very High Priority
-  No Action - Use Conflict
-  City Parks



0 500
Feet

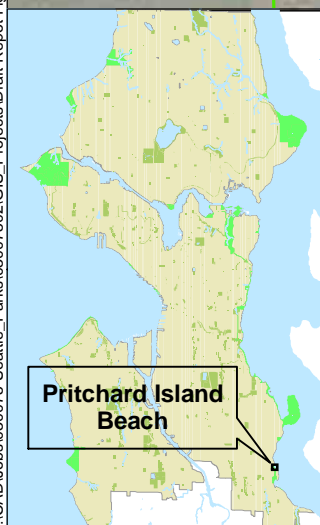


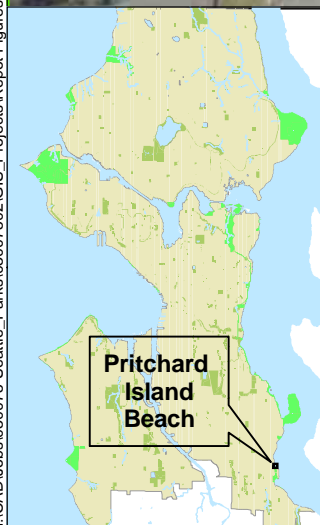
Figure 10
Pritchard Island Beach Reach Rankings
Seattle Shoreline Park Inventory and Habitat Assessment
Seattle Parks and Recreation

5.1.4.2 Reach Restoration Priorities and Restoration Prescription

Restoration priorities for Pritchard Island Beach indicated a *very low priority* for the southern reach (reach 39), and a *high priority* for the northern reach (reach 40) (Figure 10). This indicates that the northern reach would benefit most from restoration actions, and that habitat value at the southern reach could be augmented by simple restoration actions and conservation (see Section 4.2). In the northern reach, the concrete wall could be removed in places and the shoreline regraded, adding additional substrate where necessary to adjust the grade (Figure 11). The concrete steps and swim beach could be left intact. In both the northern and southern reaches, plantings could be installed at the park edges, avoiding the swim beach area where views and swimming use are important. This would preserve the recreational use of the park, while substantially increasing the park's potential to provide quality habitat.

5.1.4.3 Restoration of Ecological Functions for Juvenile Salmonid Habitat

Similar to parks discussed previously, the above restoration project at Pritchard Island Beach would address all of the five functions identified as important for salmonid habitat in littoral areas: Prey Production, Predator Refuge, Physiological Refuge, High Energy Refuge, and Migratory Corridors (Section 2.3). Increasing the amount of native vegetation at the shoreline would address prey production by increasing detritus delivery to the substrate. Also, the addition of overhanging vegetation would provide refuge from predators and provide localized areas of favorable light and temperature conditions. By removing the concrete wall, water depths and velocities would be decreased at the water's edge, promoting decreased energy demand on juvenile salmonids in the restored habitat. Restoration at this park would establish another area of high-quality habitat linking other south Lake Washington parks important to juvenile salmon migration.



Pritchard Island Beach Priority Restoration Site

Restoration Opportunities

- Remove Overwater Structures
- Remove Bulkhead
- Create Gently Sloping Shoreline
- Place Fine Grained Beach Substrate
- Control Invasive Species
- Enhance Riparian Vegetation



0 400
Feet

5.1.5 Seward Park

5.1.5.1 Current Reach Conditions

Seward Park is composed of 12 reaches which vary in shoreline habitat features, with armoring ranging from unarmored shores to concrete walls, and vegetation ranging from abundant overhanging vegetation to sparse turfgrass groundcover (Figure 12). The reaches at the south end of the park are adjacent to tennis courts, a parking lot, and an art studio, and generally contain riprap or stacked concrete armor and have moderate or little cover (reaches 44 to 46). The reaches on Bailey Peninsula are characterized by steep or moderately steep slopes with various armoring types, mixed cover, and varying substrate sizes (reaches 47 to 52 and 1005). One of these reaches (reach 51) contains the site for a substrate placement experiment conducted by the U.S. Army Corps of Engineers, comparing juvenile salmon use of different-sized substrates. Seattle Parks and Recreation is planning a similar substrate placement project for the vicinity of reach 1005. Reaches on the swim-beach side of Bailey Peninsula are generally characterized by moderately steep or gentle slopes, little or no armoring, and varied cover (reaches 53 to 54). These reaches contain the heavily used swim beach area, which is backed by a vertical concrete wall and concrete steps. In Lake Washington, juvenile salmon have been documented using swim beaches like this one; however, the public generally utilizes swim beaches in the summer after the majority of juvenile salmon have migrated through the area.

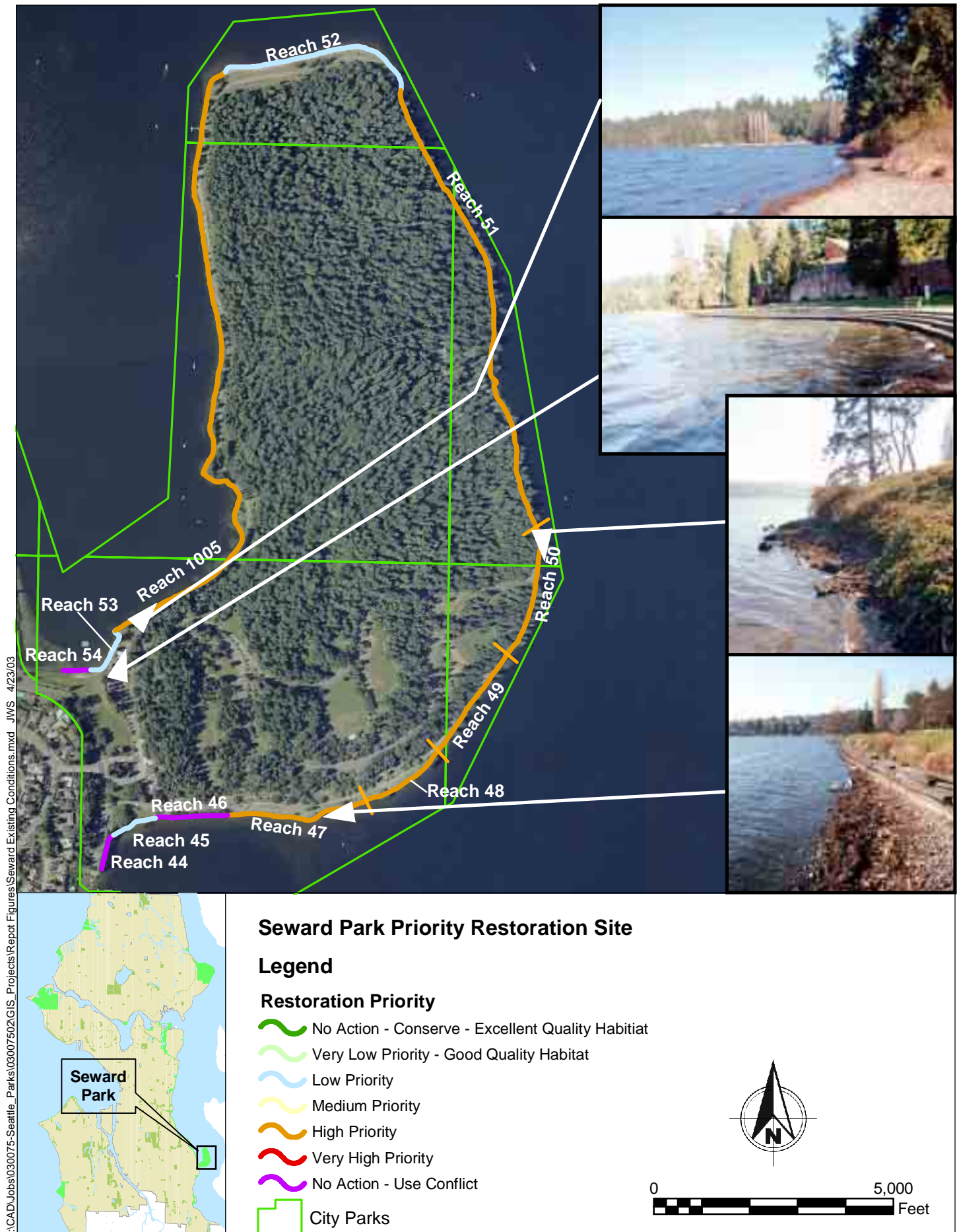


Figure 12
Seward Park Reach Rankings
 Seattle Shoreline Park Inventory and Habitat Assessment
 Seattle Parks and Recreation

5.1.5.2 Reach Restoration Priorities and Restoration Prescription

Restoration priorities for this park indicated *no action – use conflict* and *low priority* designations for the southern reaches (reaches 44 to 46), *high priority* for the Bailey Peninsula reaches (reaches 47 to 52 and 1005), and *low priority* or *no action – use conflict* for the swim beach and area nearby (reaches 53,54) (Figure 12). Therefore, the restoration prescription for Seward Park focuses on restoring the reaches on Bailey Peninsula by removing armoring, regrading the shoreline to create gentler slopes, and adding smaller substrates in places. Also, invasive vegetation could be removed, and native vegetation could be planted to increase overhanging cover, avoiding the large, healthy conifers and established native vegetation (Figure 13). This would allow habitat restoration where it is most needed, while maintaining key park uses. This would maintain the recreational value the park, while substantially increasing the park's potential to provide quality habitat.

5.1.5.3 Restoration of Ecological Functions for Juvenile Salmonid Habitat

Similar to the parks discussed previously, the above restoration project at Seward Park would address all of the five functions identified as important for salmonid habitat in littoral areas: Prey Production, Predator Refuge, Physiological Refuge, High Energy Refuge, and Migratory Corridors (Section 2.3). Increasing the amount of native vegetation at the shoreline would address prey production by increasing detritus delivery to the substrate. Also, the addition of overhanging vegetation would provide refuge from predators and provide localized areas of favorable light and temperature conditions. By removing riprap and debris armoring, water depths and velocities would be decreased at the water's edge, promoting decreased energy demand on juvenile salmonids in the restored habitat. Restoration of the Seward Park shoreline would establish a substantial length of uninterrupted, high-quality edge habitat at the park, in addition to providing a link to the other south Lake Washington parks important to juvenile salmon migration.



Seward Park Priority Restoration Site

Restoration Opportunities

- Remove Overwater Structures
- Remove Bulkhead
- Create Gently Sloping Shoreline
- Place Fine Grained Beach Substrate
- Control Invasive Species
- Enhance Riparian Vegetation

Legend

 City Parks



0 4,000
Feet

5.2 Conservation Sites

Reaches meriting conservation were identified from the list of all reaches considered. These reaches were placed on one of two levels for conservation priority based on the scoring system. Parks containing a reach with a *no action – excellent quality habitat* ranking were considered very high conservation priority because they are the best habitat of all parks considered. Parks containing a reach with the combination of *low* Habitat Improvement Potential and *high* Landscape Consideration were considered high conservation priority for several reasons. *Low* Habitat Improvement potential indicates that the habitat would improve very little with restoration, meaning that it is already high quality habitat; *high* Landscape Consideration indicates that the habitat is important for juvenile salmon on a landscape scale. The combination of high quality habitat and important landscape position indicate that the reach should be conserved at a high priority. The following is a discussion of the habitat conditions and justifications for those reaches meriting conservation.

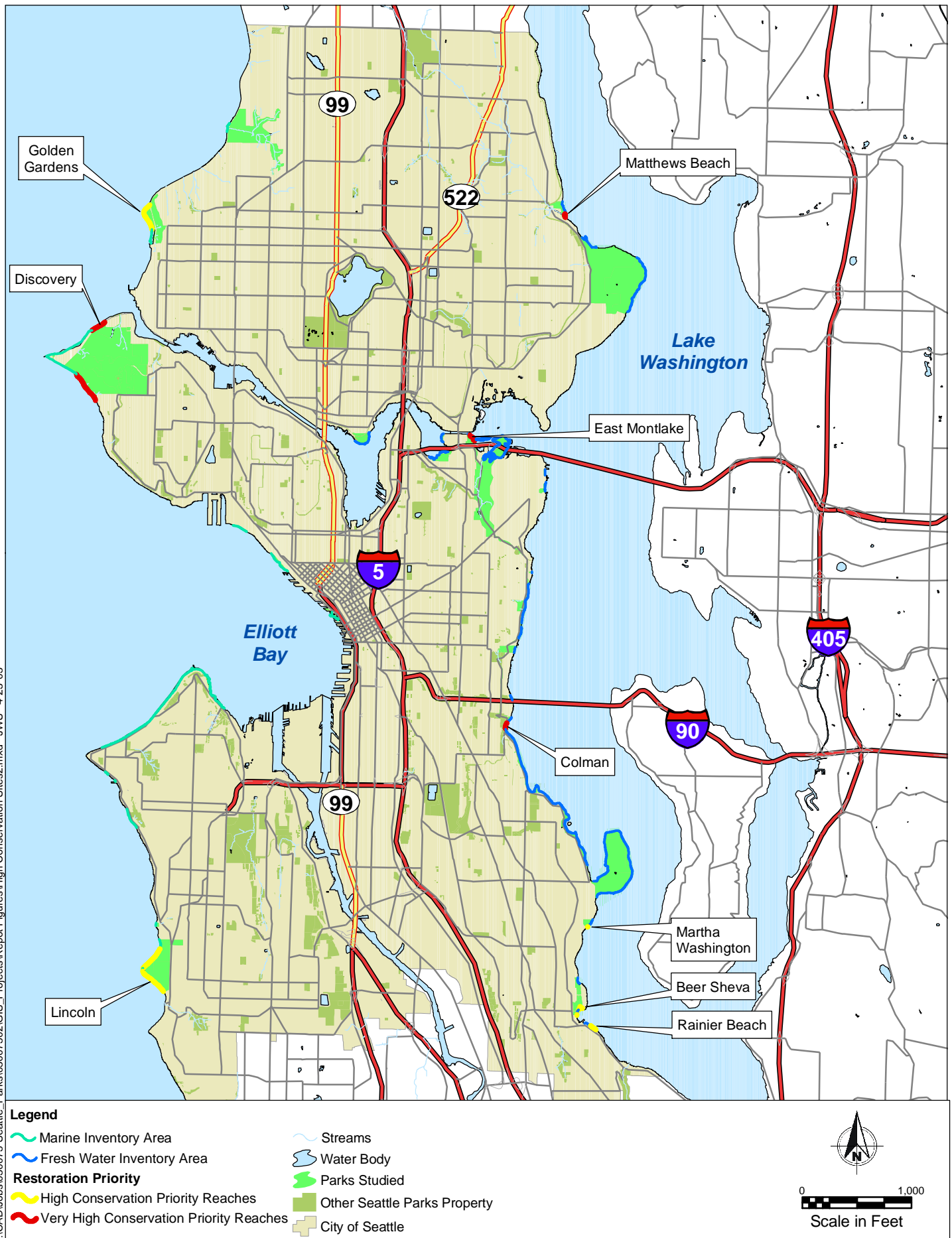
5.2.1 Highest Conservation Priority

Four parks contained reaches of very high conservation priority (Figure 14):

- Colman Park
- East Montlake Park
- Matthews Beach
- Discovery Park

These reaches represent the highest conservation priority and the highest quality juvenile salmonid habitat available on the Seattle city shoreline, and range from 148 to 1,250 feet in length, totaling 2,590 feet (0.5 mile). These parks have unarmored, gently sloping shorelines, detritus-rich, fine substrates, and often contain large woody debris. They also have abundant overhanging native vegetation contributing to cover. These reaches should be conserved to maintain the current habitat value in these areas. New shoreline modifications or built structures should be avoided at these reaches because they are the most unaltered, highly functioning shorelines within the city limits.

I:\CAD\Jobs\030075-Seattle_Parks\03007502\GIS_Projects\Report_Figures\High Conservation Sites2.mxd JWS 4-23-03



5.2.2 High Conservation Priority

Five parks contained reaches having high conservation priority:

- Rainier Beach Lake Park
- Atlantic City Boat Ramp and Beer Sheva Park
- Martha Washington Park
- Golden Gardens Park
- Lincoln Park

These include reaches from 49 to 1,931 feet in length, encompassing a total of 7,359 feet (1.4 miles) of city shoreline. These reaches exhibit various combinations of habitat features which range from high to low quality (i.e., gentle/moderate/steep slopes, native/mixed/invasive vegetation). Therefore, certain features of these reaches could be conserved, while others could be removed. For example, the gently sloping shorelines, native vegetation, and small substrates of these reaches should be conserved, while the steep slopes, invasive vegetation, and large substrates could be restored as part of future plans for these reaches. Rainier Beach, Atlantic City/Beer Sheva, and Martha Washington Parks are also restoration priority sites. This is because these particular sites have reaches in with high quality habitat condition as well as those in need of restoration. This fact, combined with the parks' landscape location relative to the Cedar River as well as their recreational uses, positions them well for both restoration and conservation efforts.

5.2.3 Other Conservation Areas

In addition to the highest priority conservation reaches discussed in this document, we identified several other general areas characteristic of Seattle shoreline parks that could merit conservation attention. Forage fish spawning sites, including those at Alki Beach, Golden Gardens Park, and Lincoln Park (KCDNR 2001) could be considered for conservation because they provide abundant prey resources for juvenile salmonids feeding and rearing in the nearshore environment. Eelgrass patches are also known to contribute to juvenile salmonid prey resources; these are present at the following parks (KCDNR 2001):

- Carkeek Park
- Golden Gardens Park
- Discovery Park
- Alki Beach Park

Swim beaches could also merit conservation because they contain the small substrates and gently sloping shorelines characteristic of higher quality juvenile salmonid habitat. When comparing park use and fish use, swim beaches present a unique opportunity for these uses to coexist because juvenile salmonids are typically present at these beaches earlier in the season than most recreational use occurs. Also, even though most swim beaches are backed by a concrete wall, with few exceptions, the walls are typically shoreward of OHW line and tend to function more as a sand/turfgrass boundary rather than a shoreline armoring device. Thus, swim beaches could be considered a moderate conservation priority; any modifications to swim beaches in the future should aim to maintain or improve the features characteristic of quality habitat. Swim beaches are present at the following parks:

- Pritchard Island Beach
- Seward Park
- Madrona Park
- Colman Park
- Madison Park
- Sand Point Magnuson Park
- Matthews Beach
- Golden Gardens Park

6 CONCLUSIONS

This inventory and assessment project was unique in several ways. First, in using park reaches to describe habitat features, the results of this assessment retain essential site-specific information at a resolution at which it is most useful for planning and designing restoration projects. The reach approach allowed flexibility in restoration opportunities depending on park uses and resulted in workable, detailed restoration prescriptions for particular shoreline areas.

Second, the analytical approach provides a way to organize restoration opportunities across diverse shoreline parks while balancing recreational uses with juvenile salmonid needs. To accomplish this, parks were considered in context of their site-specific recreation uses and facilities, as well as the potential to provide habitat connectivity in critical juvenile salmonid use areas along the shoreline. By considering recreation uses and benefits to salmon early on, the most promising, feasible projects have been highlighted. The limited distribution and size of shoreline land parcels is often a challenge when considering restoration opportunities. In this project, Parks' ownership of these sizeable, important tracts of habitat was a positive factor. Hence, this opportunity represents a significant difference from the often-criticized 'piecemeal approach' to restoration of salmonid habitats. In that sense, this project provides Parks with a unique opportunity and tool to prioritize restoration for degraded habitat in some of the most undeveloped land within the city limits.

With these results in hand, the next steps to implementing the restoration opportunities identified here include the following:

- Coordinate with other city partners to facilitate agreement and cooperation among stakeholders for the scope and design of these projects. For example, at Beer Sheva Park, Seattle Public Utilities may be involved in daylighting Mapes Creek; SPU will need to be consulted to design adjacent work.
- Prepare conceptual design and costs
- Obtain funding
- Begin environmental review and obtain permits
- Prepare final design, specifications, and costs
- Begin construction

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